STUDIES OF TWO VIRUSES CAUSING MOSAIC DISEASES OF SOYBEANS

BY

ROBERT ARMINE CONOVER

B. S., Culver-Stockton College, 1939

M. S., State University of Iowa, 1941

AN ABSTRACT OF A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
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ACKNOWLEDGMENT

The author takes this opportunity to express his sincere appreciation to Doctor W. B. Allington for his interest and guidance in this work. It is also a pleasure to thank Professor Neil E. Stevens and Professor O. Tippo for friendly counsel and assistance during the course of graduate studies.

STUDIES ON TWO VIRUSES CAUSING MOSAIC DISEASES OF SOYBEAN

The great expansion of soybean (*Soja max* Piper) culture in recent years has led to a large scale breeding program, and to an increased study of the diseases of this crop. In 1916 Clinton (1) described the symptoms of soybean mosaic; in 1921 Gardner and Kendrick (2) established the virus nature of the disease, and in 1924 they (3) showed that the virus was transmitted from generation to generation through the seed of infected plants. Since that time almost no work has been done on the disease in this country. Observations by a number of pathologists indicate that mosaic is present in all the major soybean growing areas. The feeling has arisen that the generally tolerant commercial varieties of soybeans are "resistant" to mosaic as long as they are grown in the area to which they are adapted, but if grown in a different area are "suscpetible." Wide differences in mosaic symptoms suggested that more than one virus might well be responsible for the mosaic of soybean. This investigation was made to clarify a number of these aspects of our knowledge of soybean mosaic.

Two distinct viruses, obtained from a total of 32 isolations of viruses from diseased soybeans, were studied in the greenhouse. The properties, host ranges, insect transmission, seed transmission, and the symptomology of the diseases caused by these two viruses were determined according to the usual methods.

Rugose mosaic, caused by *Soja virus 1* K. M. Smith (5), is a disease that is characterized, on the vegetable-type variety Bansei, by dark green, swollen, puffy areas arranged along and among the major veins of the leaves. Occasionally the margins and the areas among the vesicles are yellowed. Leaves are misshapen, and stunting of both leaves and stems is common. On oil-type varieties, such as Lincoln, symptoms

are much milder; the margins of the leaflets are wavy and irregularly curled under, the dark green vesicles are not formed, but some mottling is present. Pod set on diseased plants is reduced but few symptoms are produced on the pods. Air temperature greatly alters the symptomology of rugose mosaic. Plants, grown for 30 days at a constant temperature of 18.5°C., exhibit very severe symptoms while similar plants grown at 29.5°C. have very mild or no symptoms. This response is most spectacular with the vegetable variety Bansei, but is distinct with oil-type soybeans. This indicates that tests to determine varietal immunity or resistance must be made at temperatures suitable for rugose mosaic symptoms to develop.

Yellow mosaic, caused by the soybean yellow-mosaic virus, is characterized by a yellow mottling of the leaves. Usually the yellowed areas are scattered uniformly over the blade, but occasionally are present as bands along the veins. Under certain conditions intense yellow islets develop in the blade. As the leaves mature, rusty necrotic spots develop in the yellowed areas. Diseased plants, as a rule, are not markedly stunted, and, in the greenhouse, pod set was not appreciably diminished, nor were symptoms produced on the pods. All soybean varieties tested reacted uniformly to this virus, and symptoms were not greatly altered by air temperature.

Soja virus 1 produced systemic infection only on soybeans. The virus was recovered only from the symptomless, inoculated primary leaves of certain varieties of *Phaseolus vulgaris L.* The properties of *Soja virus 1* were found to be as follows: Thermal inactivation point, 64-66°C.; longevity in vitro, 4-5 days; tolerance to dilution, variable from 1/1,000 to 1/40,000 in five tests. This virus was transmitted from diseased to healthy soybeans by the pea aphid (*Macrosiphum pisi* Kalt.) and by the green peach aphid (*Myzus persicae* Sulzer), but not by the onion thrip (*Thrips tabaci* Lindeman). A total of 2397 seedlings were grown from the seed of diseased plants; of these, 707 developed rugose mosaic.

In addition to soybeans, the yellow-mosaic virus produced systemic mottling of the following hosts: *Phaseolus vulgaris, Melilotus alba* Desr., *M. officinalis* (L.) Lam., *Pisum sativum* L., *Trifolium incarnatum* L., and *Vicia faba* L. The properties of the soybean yellow-mosaic virus were found to be as follows: thermal inactivation point, 54-56°C.; longevity in vitro, 3-4 days; tolerance to dilution, variable from 1/1,000 to 1/20,000 in five tests. This virus was transmitted from diseased to healthy garden beans by the pea aphid in one test. The soybean yellow-mosaic virus was not seed transmitted in a total of 6985 seedlings produced from the seed of inoculated and naturally infected plants, or in 107 garden bean seedlings from the seed of inoculated plants.

The soybean yellow-mosaic virus is regarded as being a strain of *Phaseolus virus 2,* the virus described by Pierce (4) as causing the yellow mosaic disease of garden beans. While some differences exist, a comparison of the properties, host ranges, seed transmission and symptomology in garden bean indicate that the two viruses are very similar.

The implications of the results of this investigation on the soybean breeding program are discussed. Soybeans were found to react to the viruses as individual varieties, and not as groups according to their areas of adaptation. This led to the conclusion that crosses among varieties adapted to wide differences of environment are not inherently dangerous.

A large number of plants of the Ogden variety were found to be immune to *Soja virus 1* when inoculated mechanically, and a smaller number to succumb to a systemic necrosis. Data, obtained from testing certain crosses of this variety with a susceptible variety, revealed that both the immune and necrotic reactions of Ogden were inherited. While the type of inheritance was not determined, these results indicate that the breeding of mosaic-immune soybeans might be possible.

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VITA

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